$\bar{p}$ Note #407

October 26, 1984

Trip Report

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Kernforschungszentrum, Karlsruhe, W. Germany
September 22 - 27, 1984

CERN, Geneva, Switzerland
September 27 - October 6, 1984

The purpose of this trip was to attend the conference ECOOL 84 in Karlsruhe to give an invited talk on Cooling Ring Designs, and then to attend and observe the high energy physics start-up of the Antiproton Accumulator and SPS at CERN for the fall $\bar{p}p$ colliding beams program.

My schedule was as follows:

September 22-23	En route to Karlsruhe via Zurich
September 23-26	Conference in Karlsruhe
September 27	Train to Geneva
September 27-Oct. 5	At CERN
October 5	Train to Zurich
October 6	En route to Chicago from Zurich

The conference ECOOL 84 was the most recent in a series of conferences on the subject of electron cooling theory, techniques, and devices developed around the world. The conference program is attached. There were many new developments reported concerning the techniques of electron cooling specifically designed to extend electron beam energies into the few MeV range which would allow for many new applications, mainly dealing with heavy ion beams. An impressive number of reports concerned new electron cooling facilities currently being designed or built. This is very encouraging as essentially no facilities have existed since the shutdown of the Cooling Ring at Fermilab in 1980. Some very interesting theoretical work from Novosibirsk was reported, including a controversial theory of a supercold "frozen" beam in which particles are able to perform oscillations in the transverse dimensions but cannot pass one another in longitudinal phase space, thus leading to a breakdown of the interbeam scattering theory. Much discussion was held on this theory with people leaving both convinced and non-convinced. If this theory is correct, it could explain some of the anomalities seen in the cooling time results between Novosibirsk and the CERN and Fermilab experiments.

My visit to CERN was particularly timeful as both the AA and the SPS machines had start-up troubles and in fact the high energy program did not start until the week after I arrived, giving me an opportunity to observe the start-up and appreciate all of the associated problems as opposed to simply watching the operators routinely run the program. Most of my time was spent in the PS/AA control room with the physicists in charge attempting to adjust and increase the pbar yields and accumulation rates and set up the intricate proton and pbar transfers from the AA back to the PS and finally into the SPS. The tune-up of these lines involves the reverse injection of protons from the PS to the AA, reverse injection of protons from the SPS to the PS, many shots of pbar test pulses from the AA into the PS and then the SPS, and finally the full antiproton pulses.

While I was there the overall transfer efficiency was increased from 74% to 100% ranging from pilot pulses of $1x10^9$ pbars to the high energy program of 3 pulses of 10^{10} pbars each. By the night of September 30, the high energy program was underway with luminosities of $>10^{29}/\mathrm{cm}^2$-sec seen by both UA1 and UA4 with beam lifetimes of over 100 hours for protons and 25 hours for pbars. By Monday morning UA1 had seen its first W particle.

One development by Simon van der Meer was the perfection of a computer program which automatically ensured that the number of pbars transferred out of the AA in each of the three buckets was the same. This was done by changing the core momentum cooling program just before extraction so as to create a flat shoulder on the high density side of the core. Thus the rf system could extract one bucket, move toward the stack and extract two more buckets of equal density. Previously they had been extracting one bucket from the most dense part of the core and then getting lesser buckets as they moved in toward the stack. Probably the most useful part of this visit was to see the number and the sophistication of the computer programs used to control all of the pbar accumulation and manipulation processes used at CERN and relate them to what will be needed at Fermilab.

I also spent time in the SPS control room watching them tune up their machine and saw the difficulties in coordinating the entire CERN complex from two different locations not in good communication. The Fermilab program should greatly benefit by having all operations handled in one control room. One other thing that I saw at the SPS was the ease with which their low-beta squeeze was accomplished. They injected into the SPS at a moderate beta tune then simply turned on the low-beta program and produced the squeeze for both UA1 and UA4. This looks very encouraging when considering Fermilab's desire to have two different low-beta interaction regions. The prospect of having to inject into the Tevatron with both low betas totally off and then go through a very complicated turn-on sequence, as was done for BO, has been distressing.

One final things that I did at CERN was to find out the current status of the testing of the lithium lens with which Fermilab supplied CERN. At the present time, the lens is being used as a prefocus on their target and is working very reliably. Some initial problems had been found, such as difficulties fitting the lens into the transformer, but these were solved with a bit of machining. The len was pulsed for some 130,000 times at 360 kA without beam, and since has undergone an additional 750K pulses at 260 kA with beam without failure. CERN is using the lens as a prefocusing lens instead of a collection lens and they observe no obvious pbar yield improvement. They believe that this is due to the lack of a pulsed target. Their present schedule is to remove the lens at the end of October so as not to damage it and then replace it along with a pulsed target in the Spring of 1985.

PROGRAMME FOR ECOOL 84

MONDAY, SEPTEMBER 24, 1984

9:00-9:15
WELCOME ADDRESS
9:15-10:00
INTRODUCTION TO ELECTRON COOLING THEORY
A.SORENSEN
10:00-10:30
REALISTIC CALCULATIONS ON ELECTRON COOLING IN STORAGE RINGS
A.WOLF
10:30-10:45
REVIEW OF IDEAS FOR RELATIVISTIC ELECTRON COOLING
D.CLINE

10:45-11:15
COFFEE BREAK

11:15-11:45
REVIEW OF ELECTRON COOLING EXPERIMENTS
H.POTH
12:00-12:30
STUDY OF FAST ELECTRON COOLING
V.PARKHOMCHUK

12:45-14:00
LUNCH BREAK

14:00-14:30
ELECTRON COOLING AT VERY LOW VELOCITIES
H.HERR
14:30-15:00
THE LEAR ELECTRON COOLER
C.E.HILL
15:00-15:30
THE INDIANA COOLER
R.POLLOCK

15:30-16:00
COFFEE BREAK

16:00-16:30
ELECTRON COOLING PROJECTS IN EUROPE
S.MARTIN
16:30-17:00
ELECTRON COOLING PROJECTS IN THE USSR
V.PARKHOMCHUK/D.PESTRIKOV
17:00-17:30
ELECTRON COOLING AT INS-TOKYO
T.TANABE
17:30-17:45
HEAVY ION COOLING TEST FACILITY AT HEIDELBERG
E.JAESCHKE

19:30 CONFERENCE DINNER

TUESDAY, SEPTEMBER 25, 1984

9:00-9:45
ELECTRON COOLING BETWEEN 2 MEV AND 10 MEV
F.MILLS
9:45-10:15
HIGH ENERGY ELECTRON COOLING AND RELATED DIAGNOSTICS
L.TECCHIO
10:15-10:45
INTRABEAM SCATTERING AND HIGH ENERGY ELECTRON COOLING
A.RUGGIERO

10:45-11:15
COFFEE BREAK

11:15-11:45
PROGRESS REPORT ON CONSTRUCTION OF A 3 MEV AMPERE-INTENSITY
RECIRCULATING ELECTRON BEAM
M.SUNDQUIST
11:45-12:15
COLLECTORS FOR NONMAGNETIZED ELECTRON BEAMS
D.LARSON
12:15-12:45
DIAGNOSTICS FOR ELECTRON/ION BEAMS AND COOLING
P.MOLLER-PETERSEN

12:45-14:00
LUNCH BREAK

14:00-14:30
COMPUTATION OF ELECTRON BEAM TRAJECTORIES
M.SEDLACEK
14:30-15:00
HOLLOW CATHODS FOR ELECTRON GUNS
F.KRIENEN
15:00-15:30
EFFICIENT ENERGY RECOVERY FOR ELECTRON COOLERS
I.MESHKOV, PRESENTED BY V.PARKHOMCHUCH/D.PESTRIKOV
15:30-16:00
ULTRA-HIGH-VACUUM SYSTEMS FOR COOLERS
A.PONCET

16:00-16:30
COFFEE BREAK

16:30-17:00
BEAM INSTABILITIES DURING COOLING
V.PARKHOMCHUK
17:00-17:30
EQUILIBRIUM PROPERTIES OF STORED AND COOLED BEAMS WITH INTERNAL TARG
H.O.MEYER
17:30-18:00
ORDERING EFFECTS IN COULOMB RELAXATION OF A COOL BEAM
D.PESTRIKOV

20:00
ROUND TABLE DISCUSSION

WEDNESDAY, SEPTEMBER 25, 1984

9:00-9:45
COMPARISON BETWEEN ELECTRON COOLING AND STOCHASTIC COOLING
D.MOHL
9:45-10:15
COOLING OF HEAVY ION BEAMS
B.FRANZKE
10:15-10:45
STORAGE AND COOLING OF POLARIZED PARTICLES
E.STEFFENS

10:45-11:15
COFFEE BREAK

11:15-11:45
LATTICE DESIGN FOR COOLER RINGS
D.JOHNSON
11:45-12:15
LATTICE DESIGN OF THE TARN II COOLER RING MODE
A.NODA
12:15-12:45
ELECTRON COOLING AND NEW POSSIBILITIES IN PARTICLE, NUCLEAR
AND ATOMIC PHYSICS
K.KILIAN

12:45-14:00
LUNCH BREAK

14:00-14:30
ELECTRON CAPTURE
M.BELL
14:30-15:00
LASER INDUCED ELECTRON CAPTURE AND RELATED PHYSICS
R.NEUMANN
14:30-15:00
STUDY OF DIELECTRONIC RECOMBINATION IN A SINGLE PASS EXPERIMENT
S.DATZ
15:00-15:30
AN ION-BEAM LAMP
H.PILKUHN
15:30-16:00
CHARGE TRANSFER USING AN ELECTRON COOLER RING
I.KATAYAMA
16:00-16:30
CONFERENCE SUMMARY